

Quest to Observe the Bulk Superfluid Breakdown in a Heat Flux

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A recent theory predicts that bulk superflow breaks down in a heat flux through an instability, where the fluctuations of the counterflow velocity diverge [1]. In order to observe this interesting effect a number of obstacles must be overcome. First, it was recently suggested [2] that in an ordinary thermal conductivity cell, the breakdown of superfluidity occurs initially at the hot cell boundary, not in the bulk. Second, the sample can become non-uniform due to a temperature gradient in the superfluid caused by vortices [3]. Third, the sample may become non-uniform due to a pressure gradient induced by gravity. We will present analyses of these adverse effects in the Q-T plane and discuss ways to overcome them. The possibility of using the International Space Station to remove the gravity rounding effect will be elaborated.

[1] T. C. P. Chui, D. L. Goodstein, A. W. Harter and R. Mukhopadhyay, Phys. Rev. Lett., 77, 1793 (1996).

[2] A. W. Harter, R. A. M. Lee, A. Chatto, X. Wu, T. C. P. Chui, and D. L. Goodstein, Phys. Rev. Lett. 84, 2195 (2000).

[3] H. Baddar, G. Ahlers, K. Kuehn and H. Fu, J. Low Temp. Phys. 119: (1-2) 1 (2000).